Mid Term 2 F91 Chem 130A Wemmer

1. Proteins interact with metal ions in different ways to alter their oxidation/reduction activity. For example, the formal reaction $Fe^{3+} + e^- \rightarrow Fe^{2+}$ is quite different when the iron is in an iron sulfur cluster (as in spinach ferrodoxin), or in a heme group (as in cytochrome-c). The standard reduction potentials of these systems are given in Table 4, page 171.

a. If an electrochemical cell is made up at 20°C such that one half cell has a Pt electrode 50uM total ferredoxin in solution adjusted so that the concentrations of the oxidized and reduced forms are equal, and the other has a Pt electrode with cytochrome-c, also 50uM total, half oxidized half reduced, both in pH 7 buffer. <u>What</u> will the cell potential be when these are connected?

b. If the two electrodes are simply connected with a wire allowing the current to flow freely between the two half cells, <u>what</u> will be the concentrations of oxidized and reduced protein in <u>each</u> cell when the current flow stops?

2. When sucrose (m.w. 342.3 g/mol) is dissolved in water up to a mole fraction $X_{suc} = 0.0671$, the measured vapor pressure of water above the solution at 0°C is 4.148 mm Hg. The vapor pressure of pure water at this temperature is 4.579 mm Hg, and the enthalpy of fusion for water is 6.007 kJ/mol, density of H_2O is 1 gram/cm^3 and the m.w. of H_2O is 18 grams/mol.

a. Calculate the activity coefficient of the water in the sucrose solution at 0°C.

b. Calculate the freezing point of the real sucrose solution described above.

3. A sample weighing 1.00 gram containing a mixture of a single protein and some NaCl (salt m.w. 58.4 g/mol) was dissolved to give 10.0 mLs of solution at 20°C. This was placed in an osmometer opposite a solution of pure water using a membrane which was permeable to water, Na^+, Cl^- but not protein. The resulting osmotic pressure was determined to be 0.00403 atm. When the same measurement was made with a membrane which was permeable only to water (not protein, Na^+ or Cl^-), the osmotic pressure was determined to be 0.880 atm.

a. Calculate the molecular weight of the protein.

b. What percentage error in the molecular weight would there have been if the protein had been assumed to be pure (no salt), and only the membrane permeable to water had been used?